WHAT IS CLAIMED IS:

1. An apparatus for characterizing one or more material properties for each of 5 or more samples, comprising:

a substrate having 5 or more sensors disposed thereon to form a sensor array, wherein each sensor is associated with one of said 5 or more samples and characterizes at least one material property of its associated sample;

an interconnection device electrically coupled with the sensor array; and

an electronic platform that sends signals to and receives signals from said sensor array via said interconnection device, wherein the signals received by said electronic platform correspond to said at least one material property.

2. An apparatus for characterizing one or more material properties for each of 5 or more samples, comprising:

a substrate having 5 or more sensors disposed thereon to form a sensor array, wherein each sensor is associated with one of said 5 or more samples and characterizes at least one material property of its associated sample;

a circuit board coupled to said sensor array;

a signal routing means coupled to said sensor array via said circuit board; and

an electronic platform that sends signals to and receives signals from said sensor array via said signal routing means, wherein said signal routing means selectively couples a sensor or a group of sensors in said sensor array to said electronic platform, and

wherein the signals received by said electronic platform correspond to said at least one material property.

3. An apparatus for characterizing one or more material properties for each of 5 or more samples, comprising:

a substrate having 5 or more sensors disposed thereon to form a sensor array, wherein each sensor is associated with one of said 5 or more samples and characterizes at least one material property of its associated sample;

a circuit board coupled to said sensor array via a connector, said circuit board having a signal routing means disposed thereon;

an electronic platform that sends signals to and receives signals from said sensor array via said signal routing means, wherein said signal routing means on said circuit board selectively couples a sensor or a group of sensors in said sensor array to said electronic platform, and wherein the signals received by said electronic platform correspond to at least one material property.

4. An apparatus for characterizing one or more material properties for each of 5 or more samples, comprising:

a substrate having 5 or more sensors disposed thereon to form a sensor array, wherein each sensor is associated with one of said 5 or more samples and characterizes at least one material property of its associated sample;

a circuit board including:

a signal routing means; and

electronic test circuitry for sending signals to and receiving signals from said sensor array via said signal routing means, wherein the signals received by said electronic test circuitry correspond to said at least one property of a material in the materials library, and wherein said signal routing means on said circuit board selectively couples a sensor or a group of sensor in said sensor array to said electronic test circuitry; and

a computer coupled to said circuit board for controlling said signal routing means and said electronic test circuitry, receiving signals generated by said electronic test circuitry, and generating data corresponding to at least one material property.

5. An apparatus for characterizing material properties in a materials library, comprising:

a circuit board including:

a plurality of sensors disposed on said circuit board to form a sensor array, wherein each sensor in said sensor array measures at least one property of a material in the materials library;

a signal routing means; and

electronic test circuitry for sending signals to and receiving signals from said sensor array, wherein the signals received by said electronic test circuitry correspond to said at least one property of a material in the materials library; and

a computer for controlling said plurality of sensors and said electronic test circuitry, receiving signals generated by said electronic test circuitry, and generating data corresponding to said at least one property of a material in the materials library.

6. An apparatus for characterizing material properties in a materials library, comprising:

a circuit board including:

a plurality of sensors disposed on a substrate mounted on said circuit board to form a sensor array, wherein each sensor in said sensor array measures at least one property of a material in the materials library; and

a signal routing means to route signals to and from said plurality of sensors;

electronic test circuitry for sending signals to and receiving signals from said sensor array, wherein the signals received by said electronic test circuitry correspond to said at least one property of a material in the materials library, and

a computer for controlling said plurality of sensors and said electronic test circuitry, receiving signals generated by said electronic test circuitry, and generating data corresponding to said at least one property of a material in the materials library.

7. The apparatus of claim 1, 2, 3, 4, 5 or 6, wherein the property characterized by said sensors in said sensor array is a thermal property.

8. The apparatus of claim 7, wherein the thermal property characterized by said sensor array is at least one selected from the group consisting of heat capacity, thermal conductivity, and thermal stability.

9. The apparatus of claim 7, wherein at least one sensor in said sensor array comprises:

a microthin film membrane supported by said substrate such that said sensor array is an array of microthin film windows; and

a heater/thermometer pattern disposed on said microthin film membrane.

10. The apparatus of claim 9, wherein said microthin film membrane forming said sensors is a silicon nitride membrane, and wherein said substrate supporting said silicon nitride membranes in said sensor array is a silicon wafer.

11. The apparatus of claim 7, wherein at least one sensor in said sensor array comprises:

a microthin film membrane supported by said substrate such that said sensor array is an array of microthin film windows;

a first wire disposed on said microthin film membrane, said first wire acting as a heater and a first thermometer; and

a second wire spaced apart from said first wire and disposed on said substrate, said second wire acting as a second thermometer.

12. The apparatus of claim 11, wherein said microthin film membrane forming said sensors is a silicon nitride membrane, and wherein said substrate supporting said silicon nitride membranes in said sensor array is a silicon wafer.

13. The apparatus of claim 7, wherein said substrate is made of a polymer sheet, and wherein said sensor array includes a plurality of heater/thermometers disposed on said polymer sheet.

14. The apparatus of claim 13, wherein said polymer sheet is a polyimide.

15. The apparatus of claim 13, wherein said heater/thermometer is printed on said polymer sheet via lithography.

16. The apparatus of claim 7, wherein said substrate is made of a poor thermal conducting material that is at least 100 microns thick, and wherein said sensor array includes a plurality of heater/thermometers disposed on said material.

17. The apparatus of claim 16, wherein said heater/thermometer is printed on a glass plate via lithography.

18. The apparatus of claim 7, wherein said sensor array includes a plurality of thermometers disposed on a top surface of said substrate, and wherein said substrate includes a large area heater disposed on a bottom surface of said substrate.

19. The apparatus of claim 18, wherein said substrate is made of a polymer sheet.

20. The apparatus of claim 7, wherein said substrate is made from a material having poor thermal conductivity and is placed on a heater block, and wherein said sensor array includes a plurality of temperature sensors disposed on the substrate such that a temperature difference between a first portion and a second portion of the substrate can be determined.

21. The apparatus of claim 20, wherein said substrate is a glass plate.

22. The apparatus of claim 7, wherein at least one sensor in said sensor array comprises:

a sample support with a thermal measurement pattern disposed thereon;

a gap between said sample support and said substrate for thermally isolating said sample support from said substrate; and

a plurality of bridges connecting said sample support to said substrate over said gap.

23. The apparatus of claim 1, 2, 3, 4, 5 or 6 wherein the property characterized by said sensor array is a complex dielectric constant.

24. The apparatus of claim 23, wherein at least one sensor in said sensor array comprises interdigitated electrodes disposed on said substrate.

25. The apparatus of claim 22, wherein at least one sensor in said sensor array further comprises a thermometer such that said sensor can conduct a dielectric constant measurement and a thermal measurement simultaneously.

26. The apparatus of claim 1, 2, 3, 4, 5 or 6 wherein the property characterized by said sensor array is an electrical transport property.

27. The apparatus of claim 26, wherein the electrical transport property characterized by said sensor array is at least one selected from the group of electrical resistance, Hall coefficient, magnetoresistance, thermoelectric power, and current-voltage characteristics.

28. The apparatus of claim 26, wherein at least one sensor on the sensor array comprises a plurality of electrical leads disposed on the substrate, said leads on said sensor contacting a plurality of locations on said material sample.

29. The apparatus of claim 28, wherein said leads are deposited on said substrate, and wherein said material samples in said materials library are deposited on top of said leads.

30. The apparatus of claim 28, wherein said material samples in said materials library are deposited on said substrate, and wherein said leads are deposited on top of said samples.

31. The apparatus of claim 26, further comprising means for generating a magnetic field pointing perpendicular to said substrate.

32. The apparatus of claim 31, wherein said generating means comprises a magnet that generates a magnetic field over the entire sensor array.

33. The apparatus of claim 31, wherein said generating means comprises a magnet array having a plurality of magnets arranged in the same format as said sensors in said sensor array, wherein each magnet in said magnet array corresponds with a sensor in said sensor array to generate a magnetic field over the corresponding sensor.

34. The apparatus of claim 26, further comprising means for imposing a temperature gradient across said samples in said sensor array.

35. The apparatus of claim 26, wherein said sensors in said sensor array further measure temperature, and wherein said apparatus further comprises a plurality of temperature controlled elements to impose a temperature gradient across at least one sample in said sensor array

36. The apparatus of claim 1, 2, 3, 4, 5 or 6, wherein the property characterized by said sensors in said sensor array is at least one selected from the group consisting of viscosity, density, conductivity, molecular weight, chemical concentration, capacitance, dielectric constant, mass loading, elasticity, damping, tensile strength, yield strength, ductility, toughness, hardness and magnetism.

37. The apparatus of claim 36, wherein said sensors are at least one selected from the group consisting of resonators, oscillators, and actuators.

38. The apparatus of claim 36, wherein at least one sensor in said sensor array comprises interdigitated electrodes disposed on said substrate.

39. The apparatus of claim 36, wherein at least one sensor in said sensor array comprises:

a mechanical resonator formed on said substrate; and

a piezoelectric material deposited on top of said sensor to form an acoustic wave sensing electrode.

40. The apparatus of claim 39, wherein said acoustic wave sensing electrode is operable in at least one of a surface acoustic wave resonance mode, a thickness shear mode, and a flexural plate wave resonance mode.

41. The apparatus of claim 39, wherein said acoustic wave sensing electrode acts as both a mechanical resonator and a materials characterization device.

42. The apparatus of claim 1, 2, 3, 4, 5 or 6 wherein the property characterized by said sensors in said sensor array is a magnetic property.

43. The apparatus of claim 42, wherein the sensor in the sensor array comprises a Hall effect sensor.

44. The apparatus of claim 42, wherein the sensor in the sensor array comprises a cantilever sensor such that a deflection amount of said cantilever sensor corresponds with the magnetic property of the sample.

45. The apparatus of claim 44, wherein the cantilever sensor is part of a capacitor such that a deflection amount of said cantilever sensor is detected by a capacitance change.

46. The apparatus of claim 44, wherein the cantilever sensor is attached to a piezoresistor such that a deflection amount of said cantilever sensor is detected by a change in a resistance value of the piezoresistor.

47. The apparatus of claim 1, 2, 3, 4, 5 or 6, wherein said sensor array can characterize at least two material properties on the same array.

48. The apparatus of claim 47, wherein said sensor array includes at least a first sensor for characterizing a first material property and a second sensor for characterizing a second material property.

49. The apparatus of claim 47, wherein at least one sensor in said sensor array characterizes more than one material property.

50. The apparatus of claim 1, 2, 3, 4, 5 or 6, wherein said 5 or more sensors in said sensor array are arranged in a format compatible with combinatorial chemistry instrumentation.

51. The apparatus of claim 50, wherein said sensor array is an 8x8 array with a 0.25 pitch.

52. The apparatus of claim 50, wherein said sensor array is an 8x12 array with a 9mm pitch.

53. The apparatus of claim 50, wherein said sensor array is a 16x24 array.

54. The apparatus of claim 50, wherein said sensors in said sensor array are disposed on said substrate in a planar arrangement.

55. The apparatus of claim 50, wherein said sensors in said sensor array are attached to said substrate via a plurality of sensor plates disposed in an array format and extending generally perpendicularly from said substrate.

56. The apparatus of claims 1, 2, 3, 4, 5 or 6 wherein said plurality of sensors in said sensor array are arranged in a geometric shape.

57. The apparatus of claim 56, wherein said geometric shape is a closed shape having straight sides.

58. The apparatus of claim 56, wherein said geometric shape is a closed shape having curved sides.

59. The apparatus of claim 56, wherein said geometric shape is a closed shape having both straight and curved sides.

60. The apparatus of claim 56, wherein said geometric shape is an open shape having straight sides.

61. The apparatus of claim 56, wherein said geometric shape is an open shape having curved sides.

62. The apparatus of claim 56, wherein said geometric shape is an open shape having both straight and curved sides.

63. The apparatus of claim 56, wherein said sensor array contains at least 48 sensors.

64. The apparatus of claim 56, wherein said sensor array contains at least 96 sensors.

65. The apparatus of claim 56, wherein said sensor array contains at least 128 sensors.

66. The apparatus of claim 56, wherein said sensor array contains between 5 and 400 sensors.

67. The apparatus of claim 1, further comprising a plurality of contact pads associated with each sensor on said sensor array, wherein each contact pad is disposed next to its associated sensor, and wherein said standardized interconnection device includes a circuit board that is electrically coupled with said sensor array via said contact pads.

68. The apparatus of claim 67, wherein said circuit board in said standardized interconnection device and said sensor array are coupled together via a connector, said connector being one selected from the group consisting of conducting elastomeric connectors, conducting adhesives, cantilever probes, stick probes, wafer-to-board bonding, solder bump bonding, wire bonding, spring loaded contacts, soldering, and direct pressure connection between contact pads.

69. The apparatus of claim 1, further comprising a plurality of contact pads associated with each sensor on said sensor array, wherein each contact pad is disposed at an edge of said sensor array, and wherein said standardized interconnection device includes a circuit board that is electrically coupled with said sensor array via said contact pads.

70. The apparatus of claim 69, wherein said circuit board and said sensor array are coupled through one selected from the group consisting conducting elastomeric connectors, conducting adhesives, cantilever probes, stick probes, wafer-to-board bonding, solder bump bonding, wire bonding, spring loaded contacts, soldering, and direct pressure connection between contact pads.

71. The apparatus of claim 2, 3, 4, 5 or 6, further comprising a plurality of contact pads associated with each sensor on said sensor array, wherein each contact pad is disposed next to its associated sensor.

72. The apparatus of claim 71, wherein said circuit board and said sensor array are coupled together via a connector, said connector being one selected from the group consisting of conducting elastomeric connectors, conducting adhesives, cantilever probes, stick probes, wafer-to-board bonding, solder bump bonding, wire bonding, spring loaded contacts, soldering, and direct pressure connection between contact pads.

73. The apparatus of claim 2, 3, 4, 5 or 6, further comprising a plurality of contact pads associated with each sensor on said sensor array, wherein each contact pad is disposed at an edge of said sensor array.

74. The apparatus of claim 73, wherein said circuit board and said sensor array are coupled together via a connector, said connector being one selected from the

group consisting of conducting elastomeric connectors, conducting adhesives, cantilever probes, stick probes, wafer-to-board bonding, solder bump bonding, wire bonding, spring loaded contacts, soldering, and direct pressure connection between contact pads.

75. The apparatus of claim 1, wherein said standardized interconnection device includes:

a circuit board;

connectors for coupling said circuit board to said sensor array;

a signal routing means for selectively coupling a sensor or a group of sensors in said sensor array to said electronic platform;

a first link for connecting said circuit board to said signal routing means; and

a second link for connecting said signal routing means to said electronic platform.

76. The apparatus of claim 75, wherein at least one of said first and second links is a multi-wire cable.

77. The apparatus of claim 75, wherein at least one of said first and second links is a wireless connection.

78. The apparatus of claim 1, wherein said standardized interconnection device includes:

a circuit board coupled with said sensor array and having a signal routing means disposed thereon for selectively coupling a sensor or a group of sensors in said sensor array to said electronic platform; and

a link for connecting said circuit board to said electronic platform.

79. The apparatus of claim 78, wherein said link is a multi-wire cable.

80. The apparatus of claim 78, wherein said link is a wireless connection.

81. The apparatus of claim 1, wherein said interconnection device comprises a signal routing means for selectively coupling a sensor or a group of sensors in said sensor array to said electronic platform such that said electronic platform sends signals to and receives signals from said sensor array via said signal routing means.

82. The apparatus of claim 81, wherein said electronic platform further comprises a matrix switch for selectively coupling said electronic test circuitry with said sensors in said sensor array.

83. The apparatus of claim 81, wherein said sensor array and said electronic platform are coupled together via a wireless communication device.

84. The apparatus of claim 81, wherein said electronic platform comprises one electronic measurement channel and wherein signal routing means selects one sensor at a time to connect said one sensor to said electronic measurement channel.

85. The apparatus of claim 81, wherein said electronic platform comprises two or more electronic channels, and wherein signal routing means selects a group of two or more sensors to connect to said electronic measurement channels.

86. The apparatus of claim 1, wherein said electronic platform comprises a plurality of electronic channels, such that one electronic channel corresponding to each sensor in said sensor array, and wherein said signal routing means couples said plurality of sensors to said electronic platform such that all of said sensors in said sensor array can be analyzed simultaneously.

87. The apparatus of claims 1, 2 or 3, wherein the electronic platform includes:

electronic test circuitry that receives and collects data from said sensor array; and

a computer that receives and collects data from said electronic test circuitry.

88. The apparatus of claim 87, wherein said electronic platform further comprises a matrix switch for selectively coupling said electronic test circuitry with said sensors in said sensor array.

89. The apparatus of claim 87, wherein said sensor array and said electronic platform are coupled together via a wireless communication device.

90. The apparatus of claim 87, wherein the computer is managed by software that controls data collection, data viewing, and user interface.

91. The apparatus of claims 2 or 3, wherein said signal routing means selectively couples a sensor or a group of sensors in said sensor array to said electronic platform such that said electronic platform sends signals to and receives signals from said sensor array via said signal routing means.

92. The apparatus of claims 2 or 3, wherein said electronic platform comprises one electronic measurement channel and wherein signal routing means selects one sensor at a time to connect said one sensor to said electronic measurement channel.

93. The apparatus of claims 2 or 3, wherein said electronic platform comprises two or more electronic channels, and wherein signal routing means selects a group of two or more sensors to connect to said electronic measurement channels.

94. The apparatus of claim 4, wherein said signal routing means selectively couples a sensor or group of sensors in said sensor array to said electronic test circuitry

such that said electronic test circuitry send signals to and receives signals from said sensor array via said signal routing means.

95. The apparatus of claim 93, wherein said electronic platform further comprises a matrix switch for selectively coupling said electronic test circuitry with said sensors in said sensor array.

96. The apparatus of claim 93, wherein said sensor array and said electronic platform are coupled together via a wireless communication device.

97. The apparatus of claim 4 or 6, wherein said electronic platform comprises one electronic measurement channel and wherein signal routing means selects one sensor at a time to connect said one sensor to said electronic measurement channel.

98. The apparatus of claim 4 or 6, wherein said signal routing means selects a group of two or more sensors at a time for simultaneous analysis, and wherein the apparatus further comprises two or more electronic channels connecting each of said group of sensors to said electronic test circuitry, the number of electronic channels being equal to the number of sensors in said group by said signal routing means.

99. The apparatus of claim 4 or 6, wherein said computer receives and collects data from said electronic test circuitry, and wherein the computer is managed by software that controls data selection, data viewing, and user interface.

100. The apparatus of claim 5, wherein said circuit board further comprises a signal routing means for selectively coupling a sensor or a group of sensors in said sensor array to said electronic test circuitry such that said electronic test circuitry sends signals to and receives signals from said sensor array via said signal routing means.

101. The apparatus of claim 100, further comprising a matrix switch for selectively coupling said electronic test circuitry with said sensors in said sensor array.

102. The apparatus of claim 100, wherein said sensor array and said electronic test circuitry are coupled together via a wireless communication device.

103. The apparatus of claim 100, wherein said electronic platform comprises one electronic measurement channel and wherein signal routing means selects one sensor at a time to connect said one sensor to said electronic measurement channel.

104. The apparatus of claim 100, wherein said electronic platform comprises two or more electronic channels, and wherein signal routing means selects a group of two or more sensors to connect to said electronic measurement channels.

105. The apparatus of claim 5, wherein said electronic platform comprises a plurality of electronic channels, such that one electronic channel corresponding to each sensor in said sensor array, and wherein said signal routing means couples said plurality of sensors to said electronic platform such that all of said sensors in said sensor array can be analyzed simultaneously.

106. The apparatus of claim 5, wherein the computer receives and collects data from said sensor array, and wherein the computer includes software that controls data collection, data viewing, and user interface.

107. The apparatus of claims 1, 2, 3, 4, 5 or 6, further comprising an automated material dispensing or deposition device that deposits the 5 or more samples on said sensor array.

108. The apparatus of claim 107, wherein said automated material dispensing device comprises 5 or more dispensers having an array format corresponding to the 5 or more sensors in said sensor array such that said automated material dispensing device can deposit the 5 or more samples on the sensor array simultaneously.

109. The apparatus of claim 108, wherein said automated material dispensing device are arranged in a format compatible with combinatorial chemistry instrumentation.

110. The apparatus of claim 107, wherein said automated material deposition device employs a method selected from the group consisting of sputtering, electron beam evaporation, thermal evaporation, laser ablation and chemical vapor deposition.

111. The apparatus of claim 1, 2, 3, 4, 5 or 6, further comprising a chamber enclosing the sensor array allowing for control of a variable selected from the group consisting of temperature, pressure and atmosphere.

112. The apparatus of claim 111, wherein the variable is selected from the group consisting of ultrahigh vacuum, gaseous monomer pressure, controlled humidity and solvent vapors.

add claim

add EY